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LAND CLASSIFICATION OF SOUTH-CENTRAL IOWA
FROM COMPUTER ENHANCED IMAGES

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(E75-10394) LAND CLASSIFICATION OF
SOUTH-CENTRAL IOWA FROM COMPUTER ENHANCED
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James R. Lucas
Principal Investigator
Iowa Geological Survey Remote Sensing Laboratory
Iowa Geological Survey
123 North Capitol Street
Iowa City, Iowa 52242

James V. Taranik
Principal Remote Sensing Scientist
Applications Assistance Branch
EROS Data Center
Sioux Falls, South Dakota 57198

Frederic C. Billingsley
Task Manager, Earth Observation Programs
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91103

Original photography may be purchased from
EROS Data Center
10th and Dakota Avenue
Sioux Falls, SD 57198

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Goddard Space Flight Center
Greenbelt Road
Greenbelt, Maryland 20771

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16. Abstract Digital enhancement of computer compatible tapes (CCT's) to produce land-use classification maps for portions of an eleven county area in south central Iowa is the primary objective of contract NAS5-20832. To date, two CCT scenes have been digitally enhanced at the Jet Propulsion Laboratory. In addition, the IMAGE 100 system at the EROS Data Center has been utilized for image processing. Regional planners in the project area have been contacted to schedule meetings to receive comments on the use of enhanced imagery for planning. A discussion of preliminary image evaluation and the consequent research strategy is also included. A summary table is included which indicates funds allotted and funds spent to date.			
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Introduction

The Iowa Geological Survey Remote Sensing Laboratory (IGSRSL) and the Jet Propulsion Laboratory (JPL) have been applying digital processing techniques to computer compatible tapes (CCT's) of LANDSAT multispectral scanner data to produce computer enhanced imagery for portions of an eleven county area in south central Iowa. The lack of LANDSAT-2 data over the project area, however, has forced the investigators to utilize only LANDSAT-1 tapes. Two of these CCT's have been digitally processed at JPL. Additional image processing has been accomplished at the EROS Data Center on the IMAGE 100 system. Several regional planning agencies within the project area have been contacted to receive comments concerning the usefulness of enhanced satellite imagery for planning purposes. Planner input has led to the development of a research strategy which will utilize large scale LANDSAT scenes. A summary table of expended funds and data allotment use has also been included.

Problems

The lack of acquired LANDSAT-2 data over the contract specified study area has caused some concern. To date no LANDSAT-2 data has been acquired which meets contract specifications. These specifications for imagery and computer compatible tapes (CCT's) are summarized in Table I. It must be noted, however, that three LANDSAT-1 CCT's have been procured from available imagery. The dates, identification numbers, band quality, and percent cloud cover for these tapes are as follows:

Date of Tape	Identification Number	Band Quality (Band)				Percent Cloud Cover
		#4	#5	#6	#7	
15 Apr. 1974	8 1631 16161 5 NO	8	8	8	8	Less than 10
29 Aug. 1972	8 1037 16213 5 NO	8	8	8	8	0
24 Sept. 1974	8 1793 16105 5 NO	8	8	8	8	20

These scenes will give temporal views of early spring, late summer, and early fall for the project area. The preliminary evaluation of this imagery indicates that these tapes will satisfactorily serve the contract requirements.

TABLE I

NAS5-20832 Contract Specifications for CCT's and Imagery

Specifications Established for Automated Research and Ordering
Procedure

Area - Iowa

<u>Latitude</u>	<u>Longitude</u>
41°20'N	91°42'W - 45 Mile Radius

Date Specifications

1/ 1/75 to 2/ 5/75
3/23/75 to 3/31/75
4/18/75 to 5/23/75
6/28/75 to 8/ 3/75
9/ 8/75 to 11/19/75

Option One - One Time Coverage

ERTS (LANDSAT) -2 imagery

70mm and 7.3" by 7.3" black and white positive transparencies

70mm black and white negative transparency

MSS Bands 4, 5, 6, and 7

Minimum Quality - 2

Maximum Cloud Cover - 30%

Accomplishments

The accomplishments for this quarter are summarized under the following three sections: I. Image Processing, II. Regional Planner Interaction, and III. Preliminary Imagery Analysis.

I. Image Processing

Two computer compatible tapes, whose scenes were taken 29 August 1972 and 15 April 1974, have been digitally processed at the Jet Propulsion Laboratory. These CCT's were copied and reformatted for JPL's VICAR (Video Image Communication and Retrieval) System. All bands of these scenes were also geometrically corrected with synthetic picture elements (pixels) being removed in addition to the resampling of pixels to 79.93 meter cells. This reformatting and image correction was preformed by the VERTS program. Any line drops were "fixed" by a program called ERTSFIX. The image optimization programs consisted of three types of contrast stretching--linear (3% saturation), ramp cumulative distribution function, and Gaussian (1.5 sigma saturation). The images were also titled and masked during this segment of computer processing. Positive and negative transparencies were produced on the Video Film Converter and Optronics equipment. A flow chart illustrating the computer processing at JPL is shown on Table II.

Image processing was also accomplished on the IMAGE 100 system at the EROS Data Center. The real time ability of this machine allowed large scale viewing of several selected areas on both CCT's. This in turn led to the delineation of selected study areas for further image processing. The research strategy developed for utilizing these study areas is discussed later in this report.

Table II

Flow Chart of Computer Processing
at the Jet Propulsion Laboratory (JPL)

CCT's received from Goddard Space Flight Center (GSFC)/EROS
Data Center



CCT's copied and saved at JPL in GSFC format



Computer processing at JPL using an IBM 360 Model 44 System



Utilization of Video Image Communication and Retrieval
(VICAR) System



CCT's VERTS Logged

1. CCT's put in VICAR Format
2. CCT's are geometrically corrected for:
 - a. Skew
 - b. Panoramic distortion
 - c. Mirror scan velocity profile
 - d. Synthetic pixels--pix jerked
 - e. Square pixels--aspect ratioed

Master VICAR Tape Saved



CCT's ERTSFIXed

1. Line drops "fixed"



Image Optiminization Programs

1. Contrast Stretching
 - a. Linear stretch (3% saturation)
 - b. Ramp cumulative distribution function stretch
 - c. Gaussian stretch (1.5 sigma saturation)
2. Image is masked and titled



Generation of Hard Copies

1. Transparencies are produced on the Video Film Converter and Optronics equipment

II. Regional Planner Interaction

Several regional planning agencies within the project area have been contacted to assess their interest in participating and evaluating the computer enhanced imagery as well as the thematic maps of landuse which will be generated. These planner/managers who have expressed interest in this project are:

Mr. William Miller
Assistant Director
Area XV Regional Planning Commission
Ottumwa, Iowa 52501
515-682-8014

Mr. Brian Hall
Associate Director
Central Iowa Regional Association of Local Governments
104½ East Locust Street
Des Moines, Iowa 50309
515-244-3257

Mr. Charles A. McCarty
Director
Chariton Valley Recreation, Conservation, and Development
Project
Soil Conservation Service
Centerville, Iowa 52544
515-856-3236

Mr. Homer S. Kerr
Chairman of Board of Supervisors for Keokuk County
Sigourney, Iowa 52591
515-622-2902

Dr. Jerry E. Green
Associate Planner
East Central Intergovernmental Association
Suite 22 Fischer Building
Dubuque, Iowa 52001
319-556-4166

Meetings with these organizations will be scheduled in the near future to receive comments on the use of enhanced imagery for planning.

One of the planners mentioned above, Dr. Jerry E. Green, with the assistance of the IGSRS staff has generated a regional resource map for the East Central Intergovernmental Association (ECIA) Area using existing satellite and high altitude imagery available at the Iowa Geological Survey Remote Sensing Laboratory. The land-use categories developed for this type I classification are listed in Table III, Column A. Regional planning experience in Iowa, however, has led Dr. Green to develop a desired land-use category listing. This listing is found in Table III, Column B. It is on this basis that the preliminary analysis of enhanced imagery from the Jet Propulsion Laboratory is evaluated.

III. Preliminary Image Analysis

In general, it has been found that full frame enhanced imagery (both April and August scenes) does not seem to satisfy the desired needs of Iowa regional planners. Imagery at the scale of 1:1,000,000 or 1:250,000 does not allow for the differentiation wanted in urban and concentrated development areas. Initial work, however, on the IMAGE 100 System does seem to indicate that desired differentiation for regional planning (Table III, Column B) can be made if LANDSAT data is viewed at large enough scale (1:50,000 or larger). The other land-use categories can also be differentiated.

This need to use larger scale LANDSAT imagery has led to the delineation of less than full frame areas for concentrated study. These areas are shown on figures 1 and 2. Both scenes are examples of computer enhanced images for August and April.

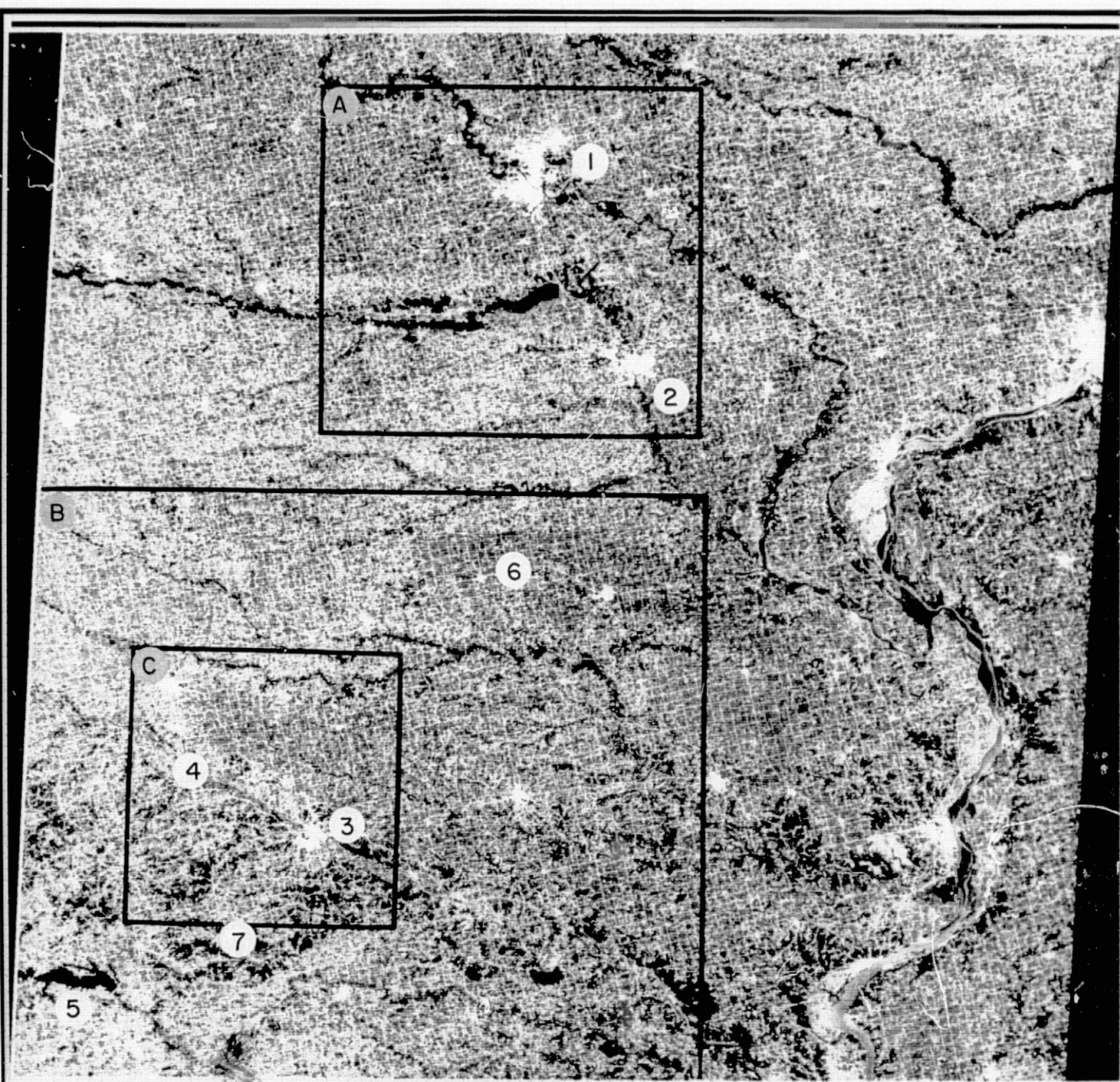
Table III

Land-Use Categories: East Central Intergovernmental Association Area
 Dr. Jerry E. Green, Associate Planner

<u>Land-Use Categories Used</u>	<u>Land-Use Categories Desired</u>
Column A	Column B
Urban Residential	3 to 4 Degrees of Urban Differentiation
Concentrated Development	Service Areas at Major Intersections Service Areas Plus Residential
Agricultural Land	Row Crops Cover Crops (Including Pasture)
Forest Land	Upland Forest Lowland Forest
Water Bodies (Greater than 10 Acres)	Water Bodies (Greater than 3 Acres)
Extractive (Greater than 10 Acres)	Extractive (Greater than 3 Acres)

Figure 1 - Computer Enhanced Image, SE Iowa, 29 August 1972,
Green Band, Gaussian Contrast Stretch Applied

(Explanation for Figure 1 on Following Page)



1007-16813-4 GRN 29AUG72 OTTUMWA 1
141-20-1071-42 H00191 20N E150 W136 PRG 89 SCALE 79.93M-POS
NACW CONTRACT INWS-20832
LAND CLASSIFICATION OF SOUTH CENTRAL IOWA
FROM COMPUTER ENHANCED IMAGES
JPL IG7POL
BILLINGSLY LUCAS THAWAN
ERTS/FM - GAUSSIAN STRETCH

WFO APR 10 1973 004307 PL 25

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Explanation for Figure 1

Computer Enhanced Image, SE Iowa, 29 August 1972, Green Band,
Geometrically Corrected, Gaussian Contrast Stretch Applied.

Numbered Circles Represent:

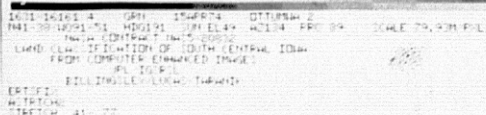
1. Cedar Rapids
2. Iowa City
3. Ottumwa
4. Des Moines River
5. Rathbun Reservoir
6. Agricultural Land--flat lying, highly productive
7. Dense Forest Land--represented by dark tonal patterns

Black Lines Delineate Portions of the Image to be Intensively
Studied.

The Lettered Circles Correspond to These Portions and are Titled
from North to South:

- A. Iowa City - Cedar Rapids Study Area
- B. SE Iowa Regional County Study Area
- c. Ottumwa Study Area

(Explanation for Figure 2 on Following Page)



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9A

Explanation for Figure 2

Computer Enhanced Image, SE Iowa, 15 April 1974, Green Band,
Geometrically Corrected, Linear Stretch Applied.

Number Circles Represent:

1. Cedar Rapids
2. Iowa City
3. Ottumwa
4. Des Moines River
5. Red Rock Reservoir
6. Agricultural Land--flat lying, highly productive

Black Lines Delineate Portions of the Image to be Intensively
Studied.

The Lettered Circles Correspond to These Portions and are Titled
from North to South:

- A. Iowa City - Cedar Rapids Study Area
- B. SE Iowa Regional County Study Area
- C. Ottumwa Study Area

The black lines represent the delineated study area boundaries. Prominent land marks are identified by numbers.

The research strategy for computer enhancement techniques are summarized in Table IV. Full frame scenes will be VERTS logged and ERTSFIXed. Study areas will be delineated and contrast stretched to optimize desired land use. Registering enhanced imagery to maps, spectral band ratioing, and multispectral machine classification will also be attempted. The generation of hard copy imagery will be used to interface with planners. The color additive viewer will be used to decide which contrast stretch is "best" for producing color composites. The Digicol density slicing equipment will be used experimentally to generate color thematic maps.

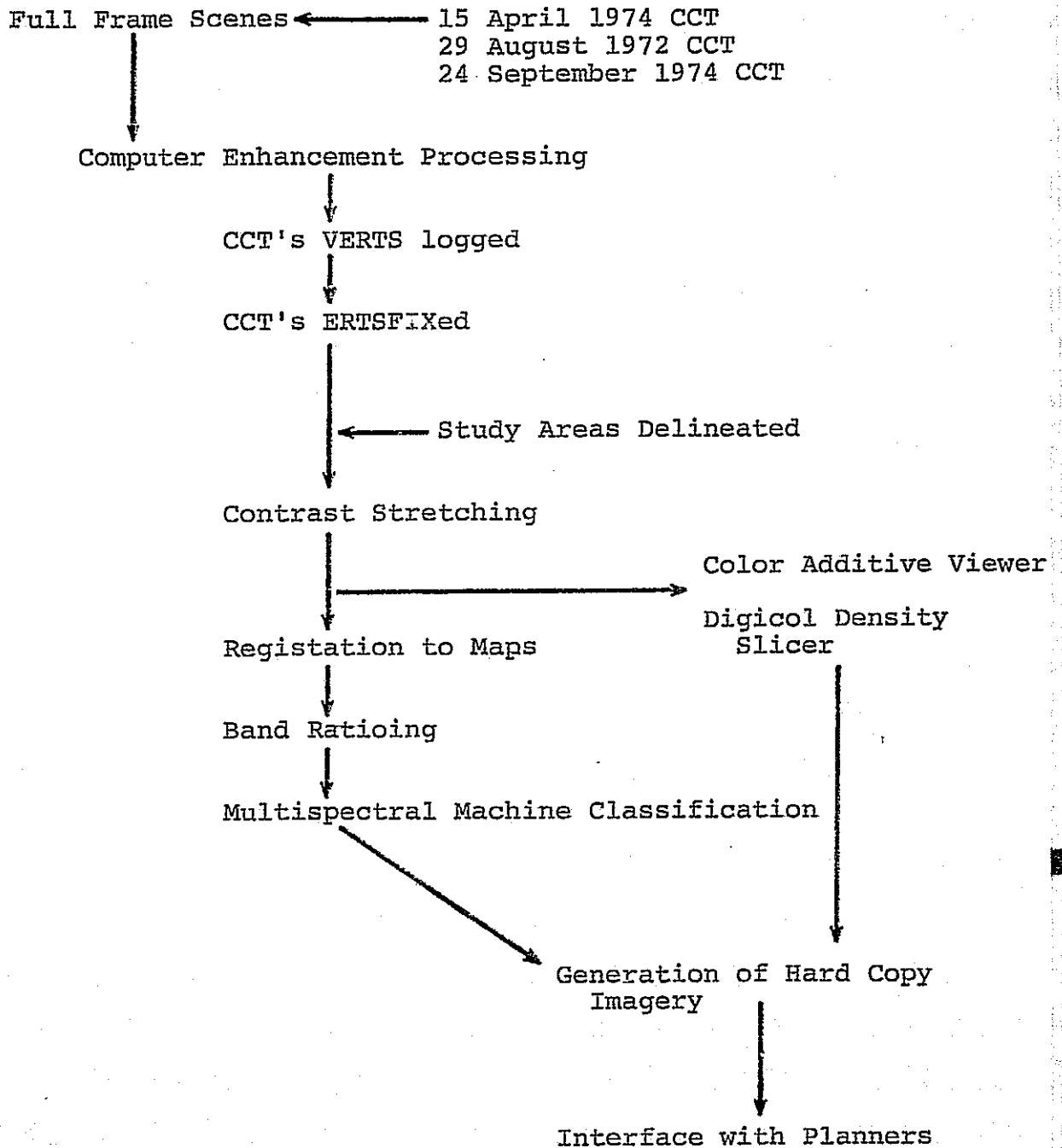
Future Research Endeavors

I. In keeping with the assessed need to utilize LANDSAT data on a large scale, pixel by pixel basis, a 16 mile square study area, centered over the city of Ottumwa, has been chosen to test this research strategy. Three contrast stretches (linear, ramp CDF, and Gaussian) will be produced for this area from the 29 August 1972 scene. Standard color composites utilizing these stretches will also be generated to test their usefulness in land-use mapping. These scenes will then be compared to a NASA high altitude color IR image taken August 1971 over the identical area.

This research approach will allow direct comparisons of large scale enhanced satellite imagery to an excellent quality,

Table IV

Research Strategy for Computer Enhancement Techniques



high altitude color IR image of the same season. This small 16 mile square sub-scene within the Ottumwa study area was chosen for the variety of land-use categories present in such a small area. Depending on the success of this research strategy, other study areas may be delineated and be tested in a similar manner.

II. Image processing of the 24 September 1974 CCT is planned during the next quarter. A trip to the Jet Propulsion Laboratory is also planned in early October by IGSRL staff.

III. Meetings with regional planners will be scheduled when appropriate enhanced imagery is available.

Funds Expended

Table V summarizes the budget allotted by NASA and funds expended by the Iowa Geological Survey Remote Sensing Laboratory, to date. The total funds expended by IGSRL during the first two quarters are \$8,264.30. IGSRL has been reimbursed \$4,636.85 by the government for expenses incurred. Payment of expenses for the months of June and July, which total \$3,627.45 are still outstanding.

Data Use

During this quarter the 24 September 1974 CCT was ordered and received. A summary table for data acquisition funds is shown on Table VI.

TABLE V
BUDGET ALLOTTED BY NASA AND FUNDS EXPENDED BY IGSRL

Contract NAS5-20832

Land Classification of South-Central Iowa from Computer Enhanced Images

Contractor:

Iowa Geological Survey Remote Sensing Laboratory (IGSRL)
Iowa Geological Survey
123 North Capitol Street
Iowa City, Iowa 52242

Element of cost	Budget Allotted by NASA	Expended Funds by IGSRL to Date
Salary for Project Manager Based on 16 Months	\$16,874.00	\$5,896.00
Employee Benefits for Project Manager	2,038.00	597.04
Travel Related to Project-Transportation	2,400.00	824.24
-Per Diem	1,600.00	611.04
Expendable Materials and Photographic Supplies	863.00	300.18
Publication Expense	5,000.00	35.80
Subtotal	<u>\$28,775.00</u>	<u>\$8,264.30</u>

Funding to the Jet Propulsion Laboratory (JPL) by NASA

Salary for JPL Scientific and Technical Staff and Computer Processing Time	20,000.00	Billed to NASA by JPL directly
Total Funding by NASA for Contract NAS5-20832	<u>\$48,775.00</u>	

Payments Received to date by IGSRL from Government.....	4,636.85
Expenses Incurred during June and July by IGSRL.....	3,627.45

TABLE VI

Data Acquisition for Contract NAS5-20832
Under Funds Allotted to the EROS Data Center by NASA

	<u>Value of Data Allowed</u>	<u>Value of Data Ordered</u>	<u>Value of Data Received</u>
CCT Account No. B0660	\$1,000.00	\$200.00	\$200.00
LANDSAT Imagery Account No. 20660	100.00	-----	-----